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Lee

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[54] **METHOD AND APPARATUS FOR OPENING AND CLOSING AN AIR OUTLET OF AN AIR CONDITIONER**

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[73] Assignee: **Samsung Electronics Co., Ltd.**, Suwon, Rep. of Korea

[21] Appl. No.: **763,142**

[22] Filed: **Dec. 10, 1996**

[51] **Int. Cl.**[6] **F24B 13/20**

[52] **U.S. Cl.** **454/233**; 454/234; 454/306; 454/316; 454/324

[58] **Field of Search** 454/230, 229, 454/231, 233, 234, 256, 306, 309, 313, 316, 324

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,020,753	5/1977	Efstratis	454/306
4,545,379	10/1985	Jenkins	454/306 X
5,461,875	10/1995	Lee et al.	454/324 X

FOREIGN PATENT DOCUMENTS

6-123466 5/1994 Japan .

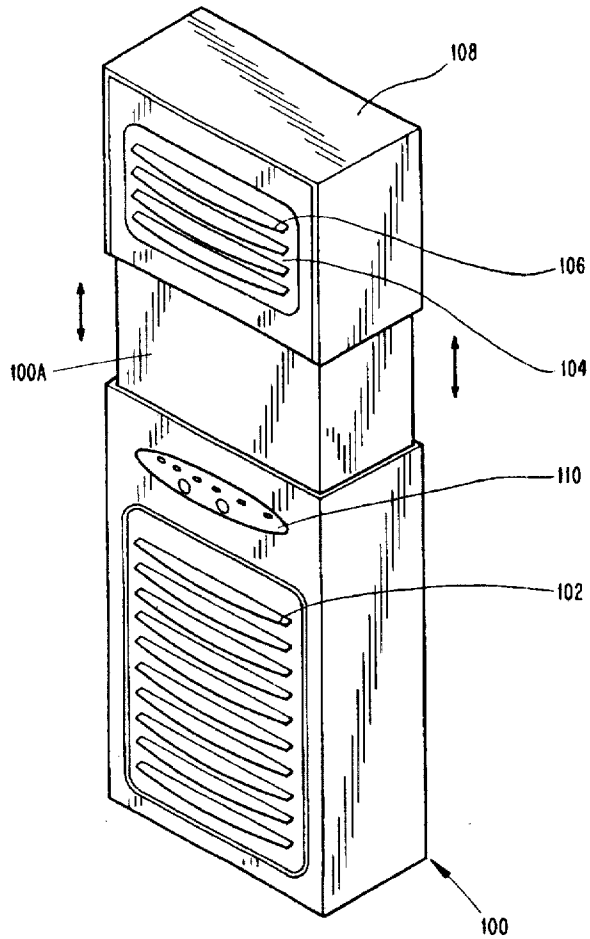
Primary Examiner—Harold Joyce

Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis, L.L.P.

[57] **ABSTRACT**

An air conditioner includes a housing having an air inlet at its lower end. An air outlet is formed in an air discharge member which is mounted at an upper end of the housing. The discharge member is vertically movable relative to the housing, whereby the outlet is closed by a portion of the housing when the discharge member is in a lowermost position and becomes progressively opened as the discharge member is raised. Sensors are provided for detecting various positions of the discharge member during its vertical movement. The discharge member is moved by a main electric motor, and an auxiliary motor is moved into an operative position for vertically moving the discharge member when the main motor malfunctions.

16 Claims, 11 Drawing Sheets



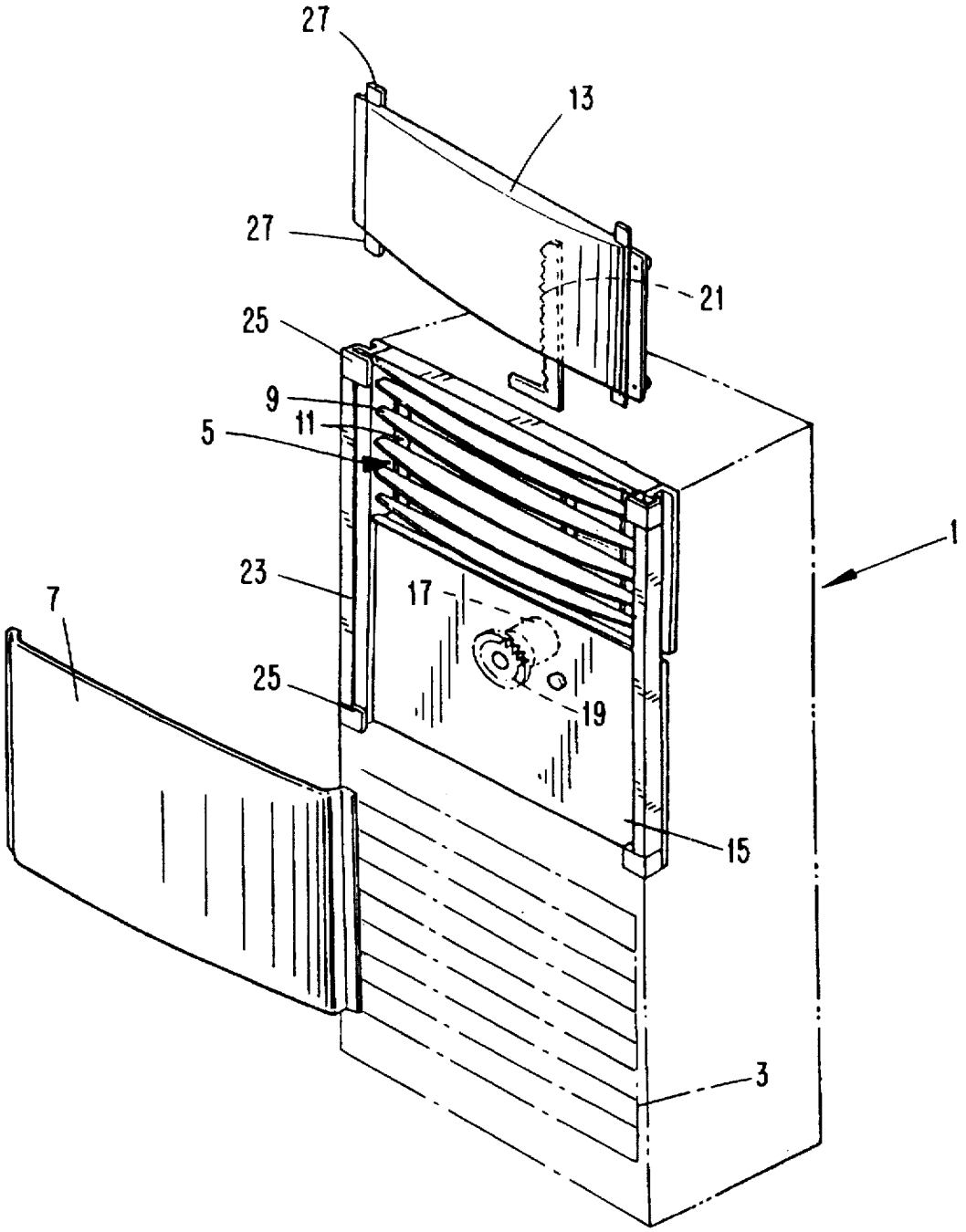


FIG. 1
(PRIOR ART)

FIG. 2

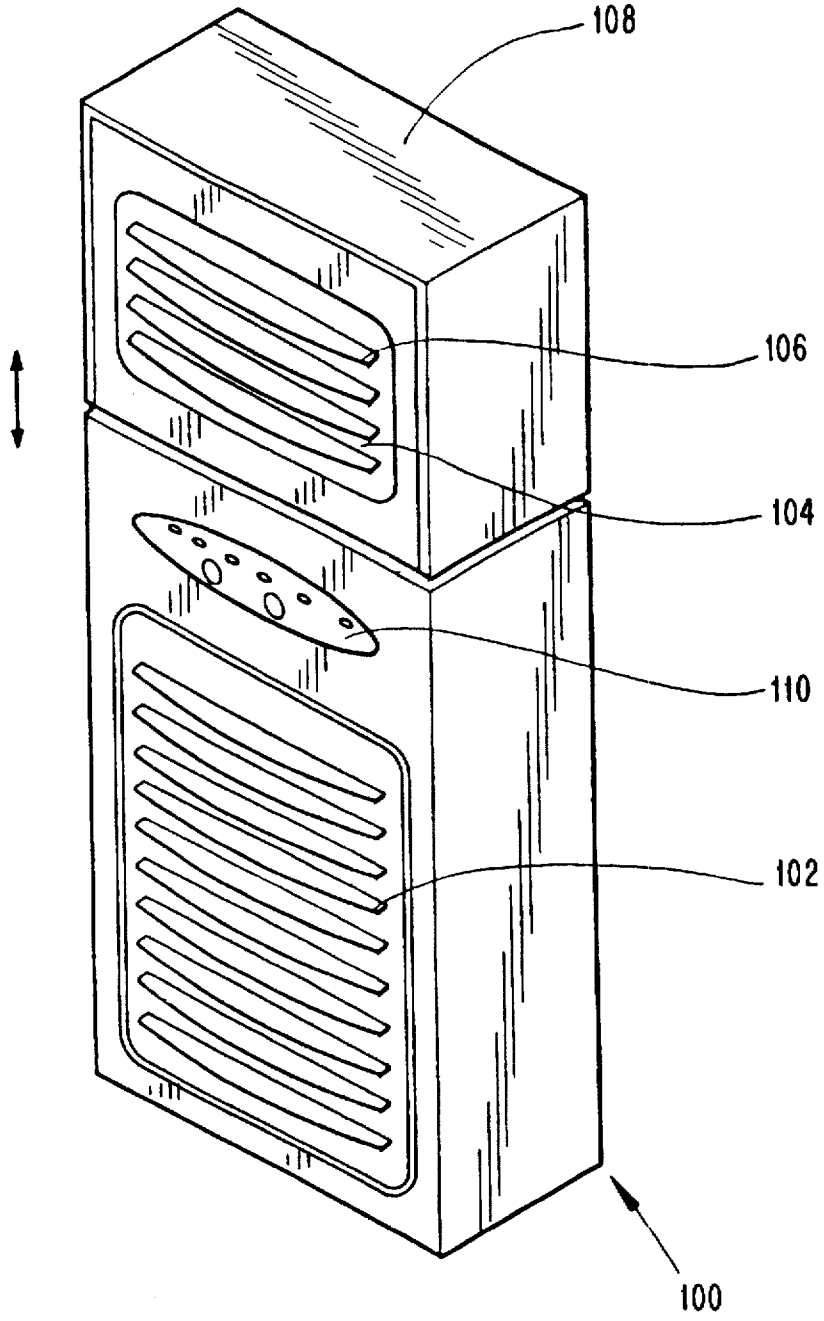


FIG. 3

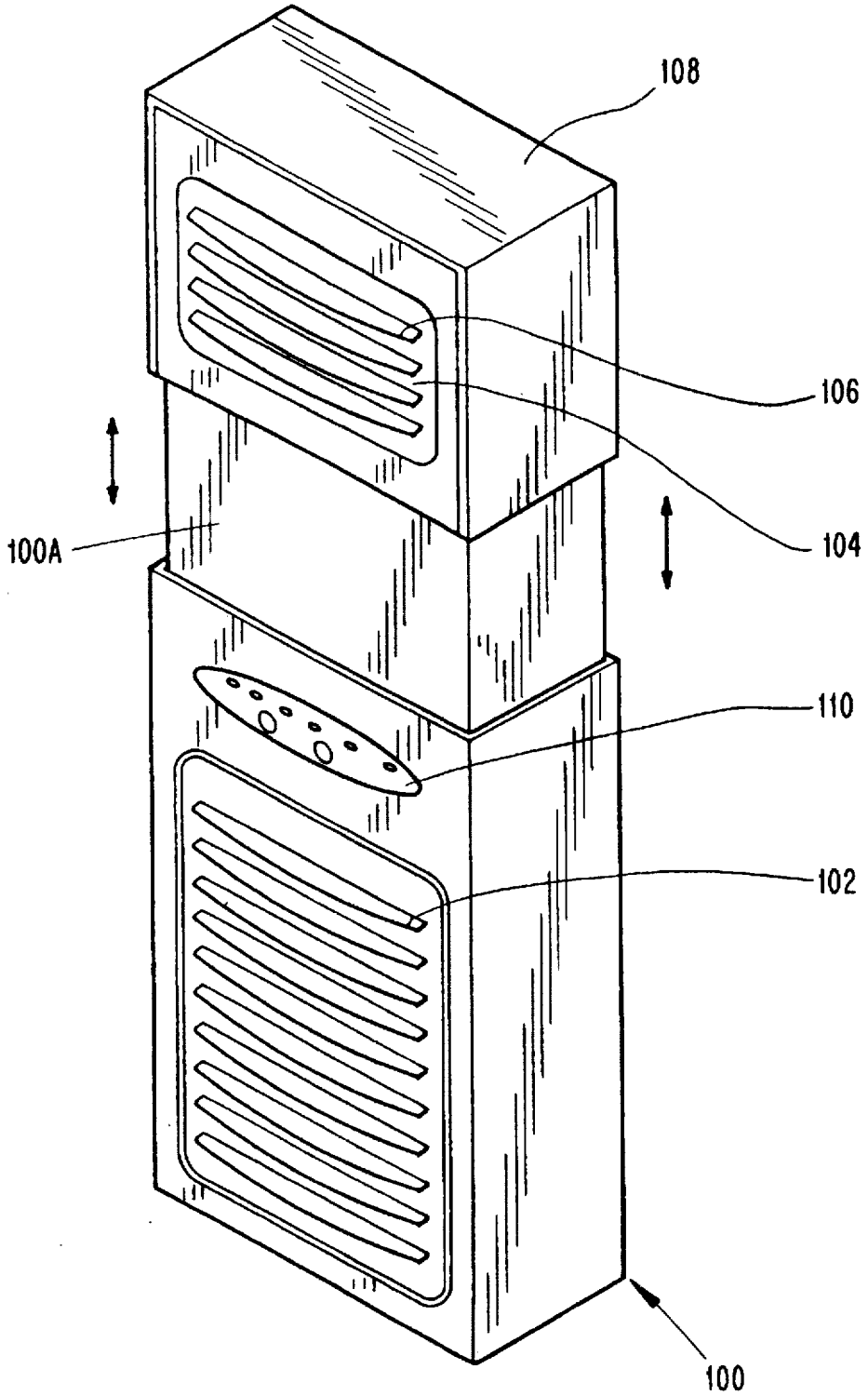


FIG. 4

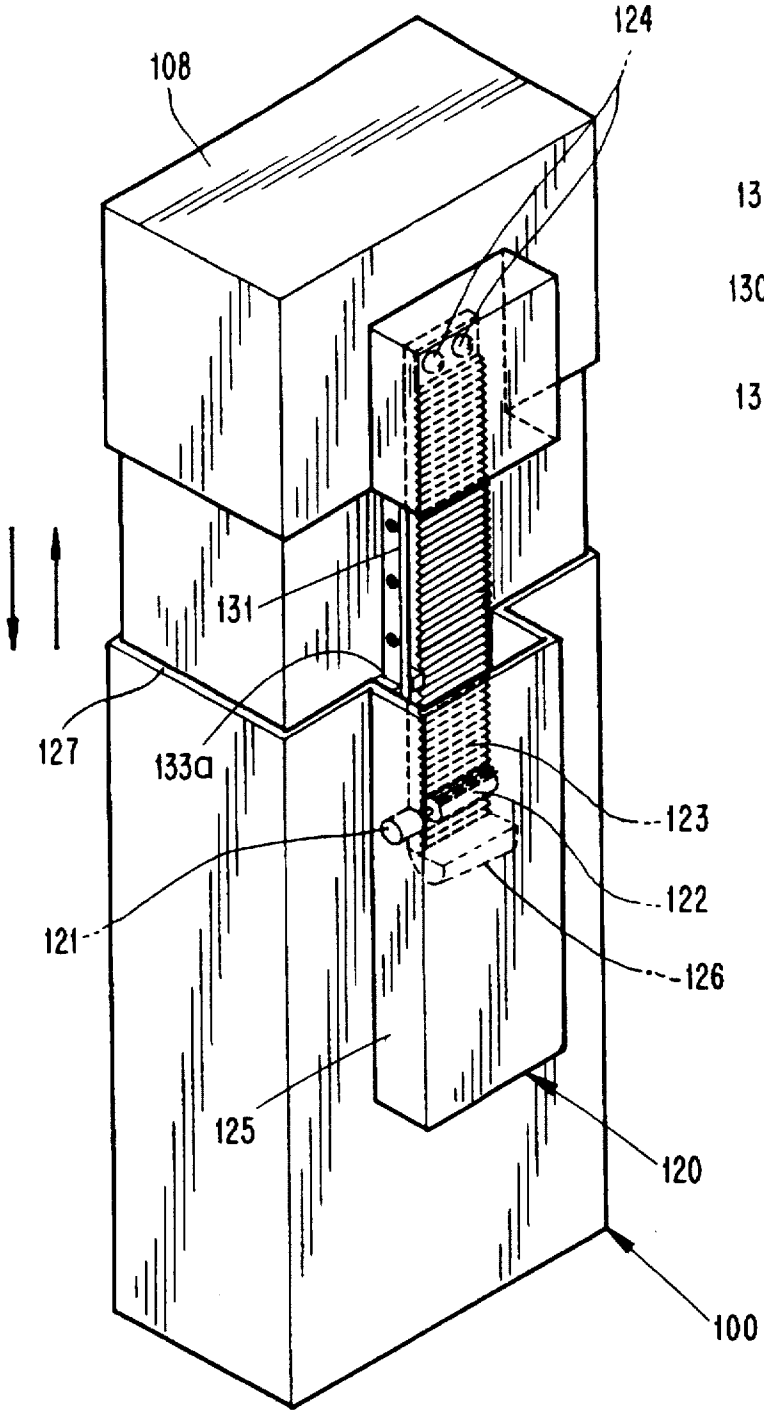

124
108
131
127
133a
123
122
121
126
125
120
100

FIG. 4A

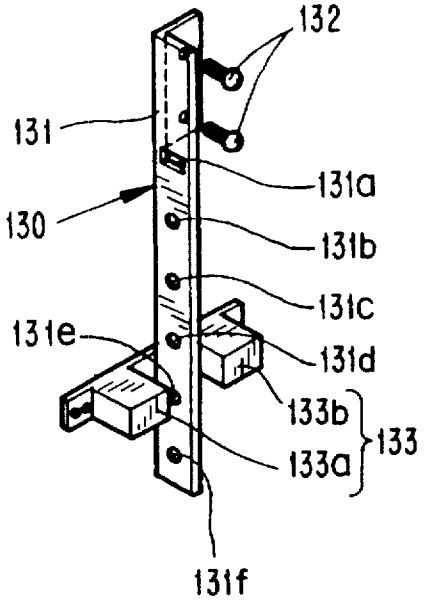

132
131
131a
130
131b
131c
131e
131d
133b
133
133a
131f

FIG. 5

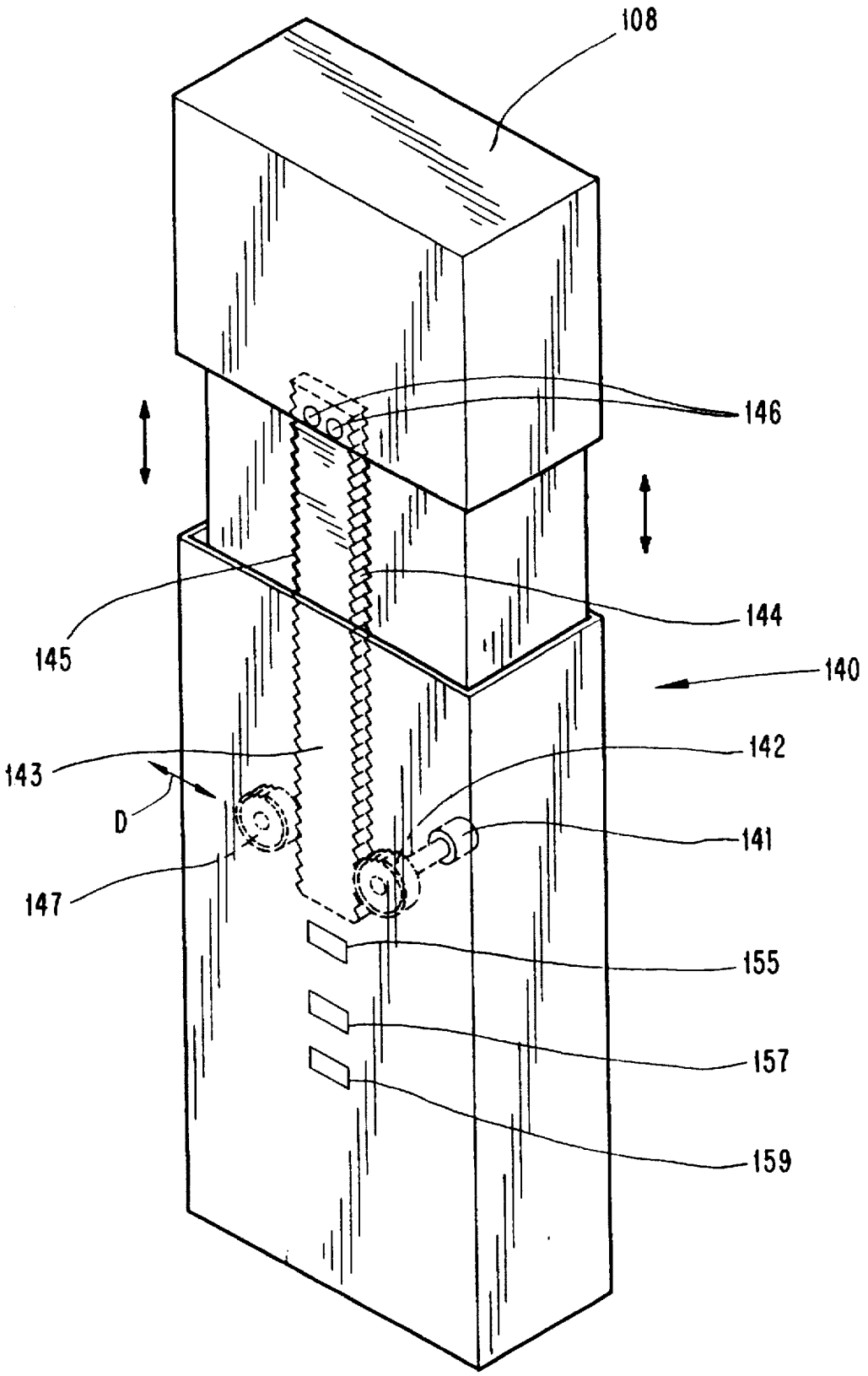


FIG. 6

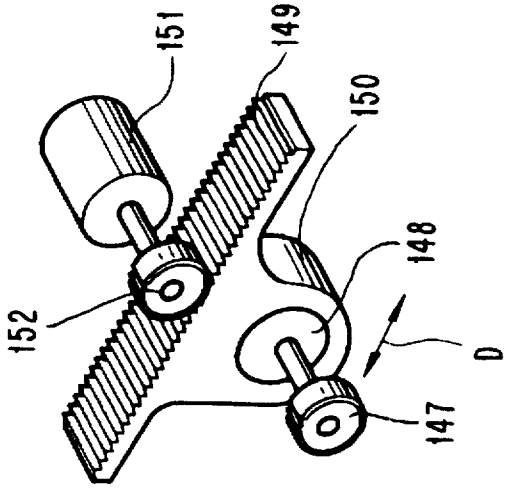
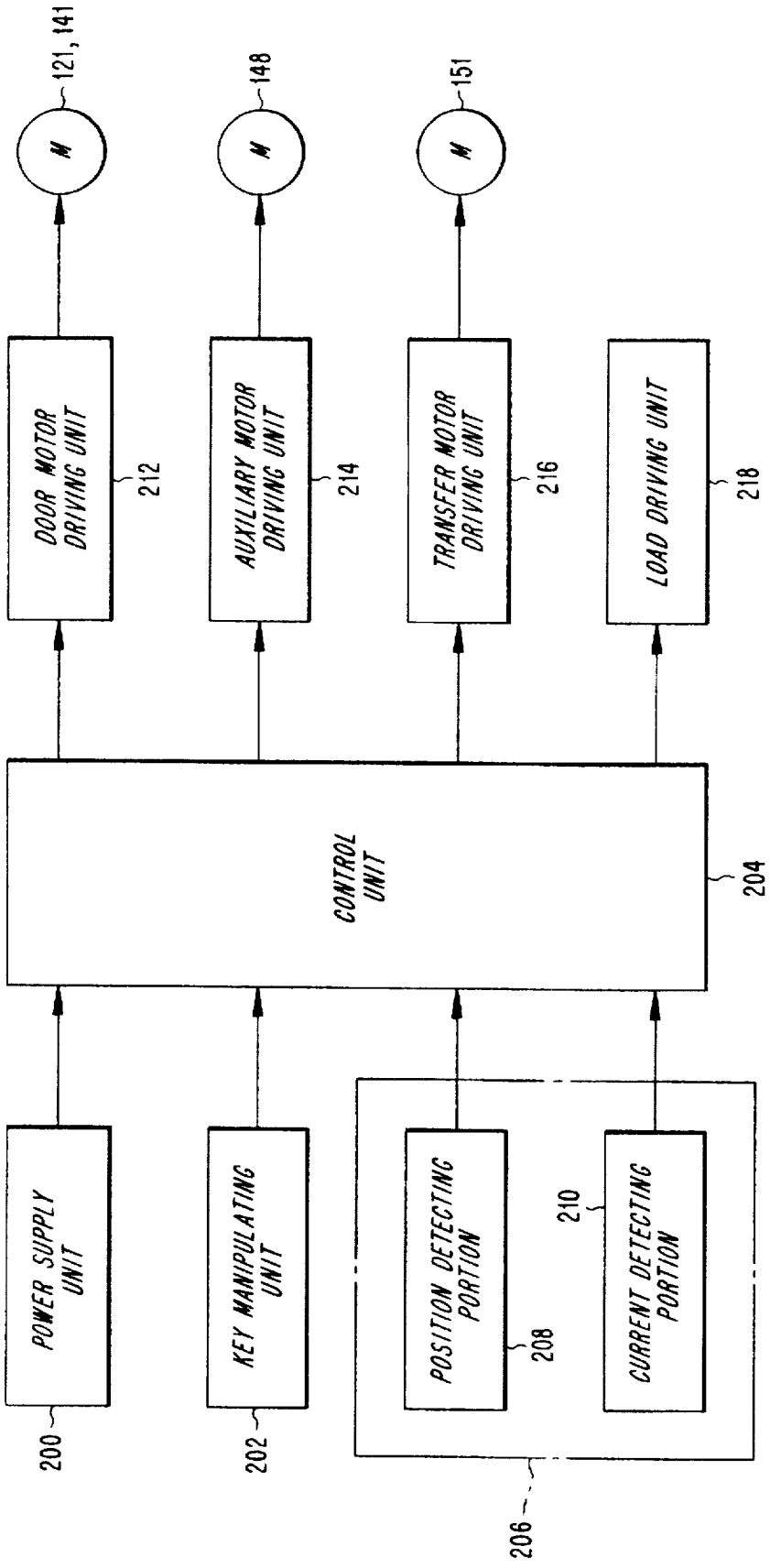


FIG. 7


121, 141
148
151
M
M
M
DOOR MOTOR DRIVING UNIT
212
AUXILIARY MOTOR DRIVING UNIT
214
TRANSFER MOTOR DRIVING UNIT
216
LOAD DRIVING UNIT
218
CONTROL UNIT
204
POWER SUPPLY UNIT
200
KEY MANIPULATING UNIT
202
POSITION DETECTING PORTION
208
CURRENT DETECTING PORTION
210
206

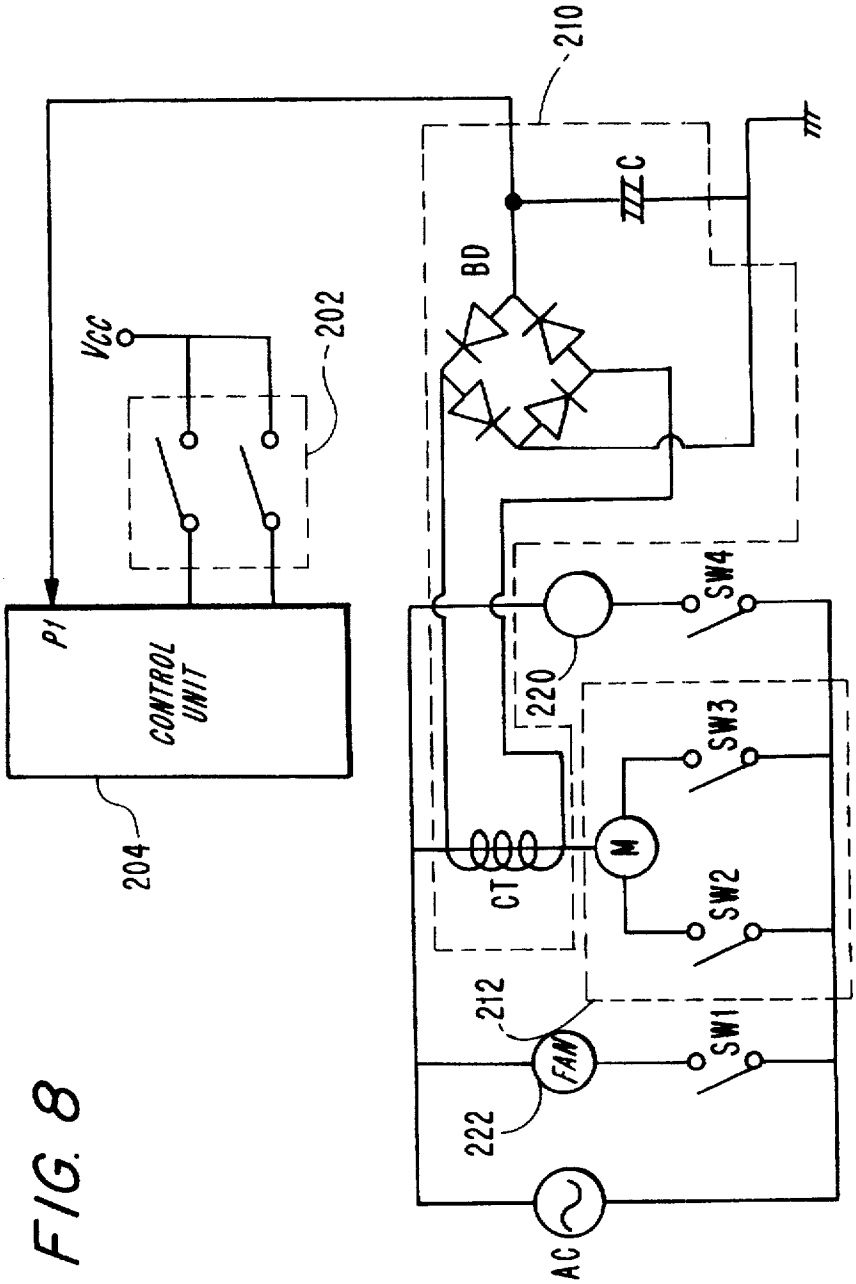

210
C
BD
Vcc
202
P1
CONTROL UNIT
204
SW4
220
SW3
M
CT
SW2
212
FAN
SW1
222
AC

FIG. 8

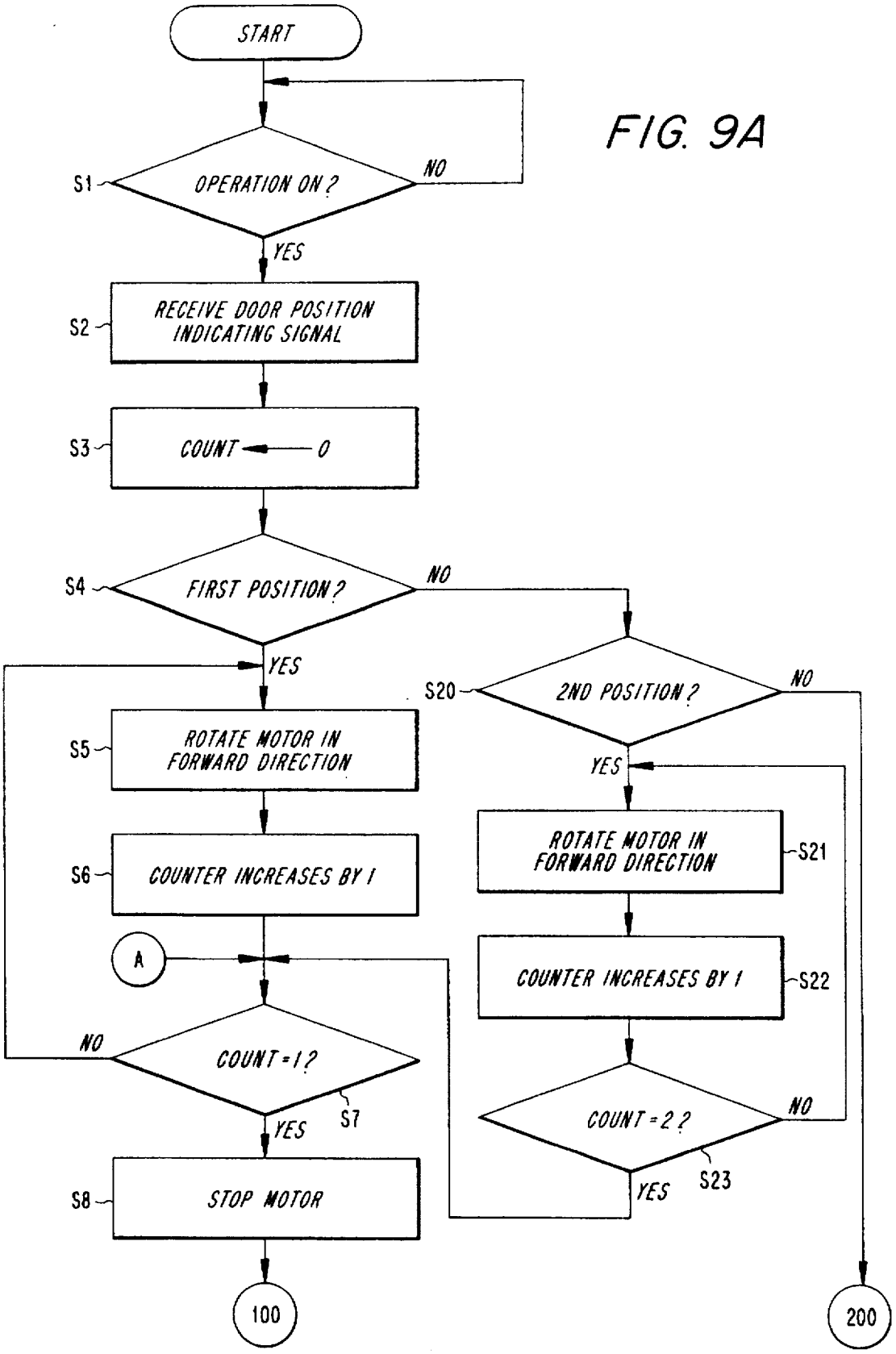

START
S1
OPERATION ON ?
NO
YES
S2
RECEIVE DOOR POSITION INDICATING SIGNAL
S3
COUNT ← 0
S4
FIRST POSITION ?
NO
YES
S5
ROTATE MOTOR IN FORWARD DIRECTION
S6
COUNTER INCREASES BY 1
A
NO
COUNT = 1 ?
S7
YES
S8
STOP MOTOR
100
S20
2ND POSITION ?
NO
YES
S21
ROTATE MOTOR IN FORWARD DIRECTION
S22
COUNTER INCREASES BY 1
COUNT = 2 ?
NO
S23
YES
200

FIG. 9A

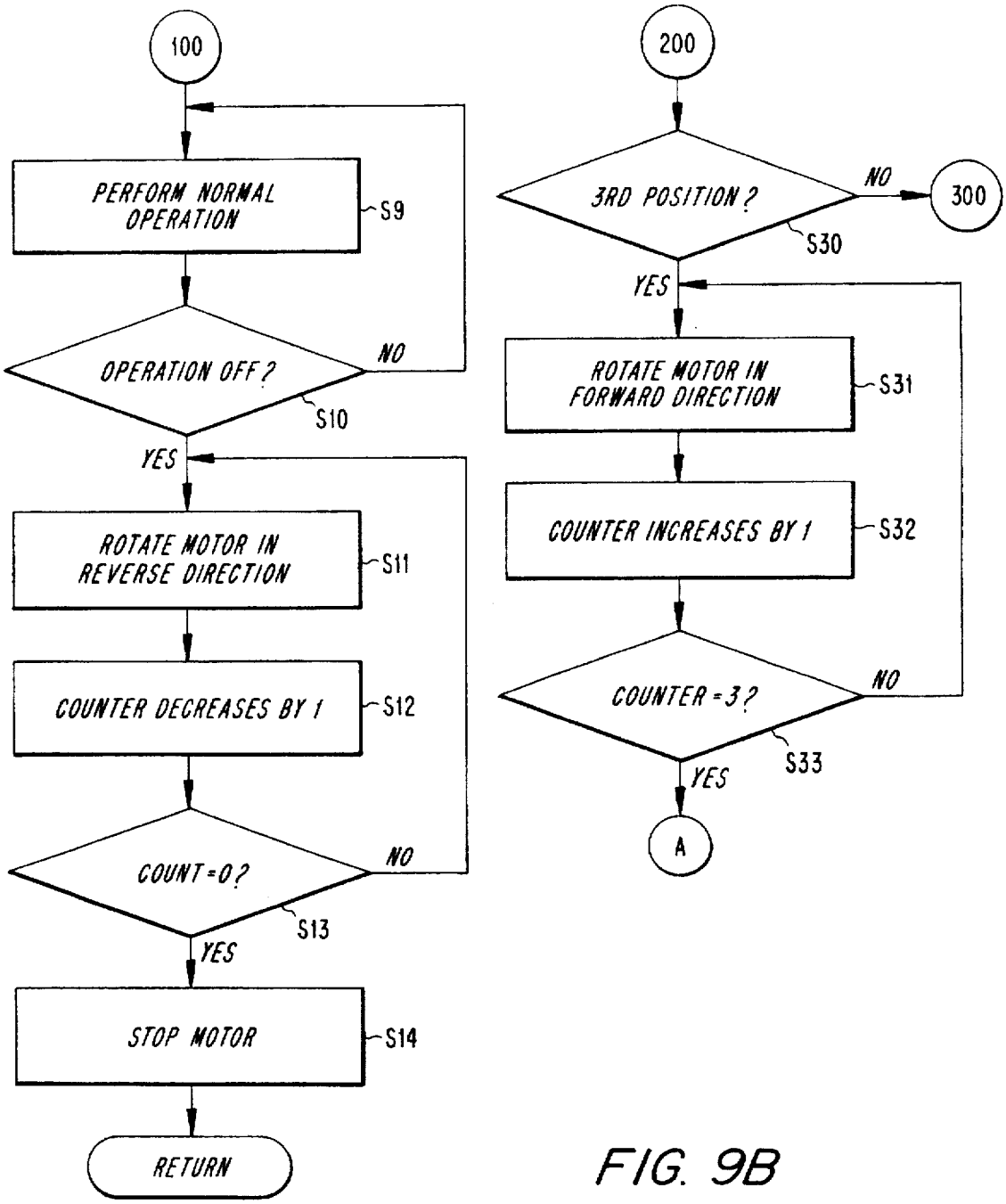
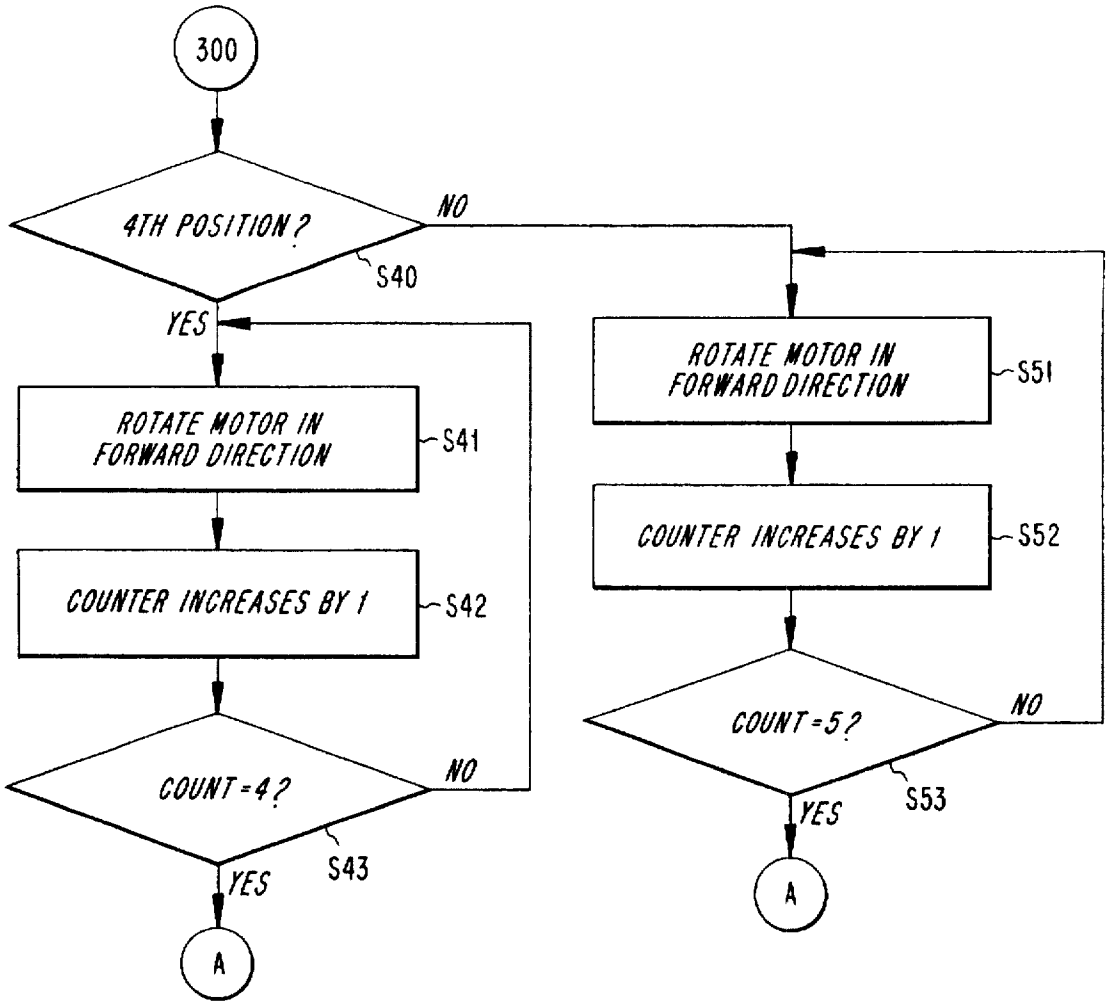

100
PERFORM NORMAL OPERATION
S9
OPERATION OFF?
NO
S10
YES
ROTATE MOTOR IN REVERSE DIRECTION
S11
COUNTER DECREASES BY 1
S12
COUNT=0?
NO
S13
YES
STOP MOTOR
S14
RETURN
200
3RD POSITION?
NO
300
S30
YES
ROTATE MOTOR IN FORWARD DIRECTION
S31
COUNTER INCREASES BY 1
S32
COUNTER=3?
NO
S33
YES
A

FIG. 9B

FIG. 9C


300
4TH POSITION?
S40
NO
YES
ROTATE MOTOR IN FORWARD DIRECTION
S41
COUNTER INCREASES BY 1
S42
COUNT=4?
S43
NO
YES
A
ROTATE MOTOR IN FORWARD DIRECTION
S51
COUNTER INCREASES BY 1
S52
COUNT=5?
S53
NO
YES
A

METHOD AND APPARATUS FOR OPENING AND CLOSING AN AIR OUTLET OF AN AIR CONDITIONER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an air conditioner having a discharge outlet to be opened or closed for preventing dust or foreign substances from passing through the discharge outlet, and more particularly to a discharge outlet opening or closing apparatus for the air conditioner.

2. Description of the Prior Art

A conventional air conditioner has, as shown in FIG. 1, a main body **1**, a suction inlet **3** arranged to suck a room air at the bottom portion of a front face of the body **1**, a discharge outlet **5** for discharging indoors the air heat-exchanged by a heat-exchanger with cold or warm air, the outlet situated at an upper portion of a front face of the body **1**, and a cover member **7** attached to the body **1** and usually designed to give a good appearance thereto and for protecting the interior thereof.

The discharge outlet **5** has blades **9** and **11** for adjusting left or right and upward or downward the air discharged indoors through the discharge outlet **5**, respectively, and is provided with a discharge outlet door **13** usually designed to give a good appearance. The door is installed upon a front face to open the discharge outlet **5**, and to close the discharge outlet **5** for preventing dust or foreign substances from passing through the discharge outlet **5** and into the main body **1** during the stand-by state of the air conditioner.

Also, driving means adapted for moving upward or downward the discharge outlet door **13** includes a supporting member **15** attached to an upper front surface of the body **1**, and a door motor **17** fixed to the supporting member **15**, for moving upward or downward the discharge outlet door **13**. A pinion **19** is axially coupled to a shaft of the door motor **17** to be rotated by the door motor **17**, and a rack **21** is mounted on the door for changing a rotary motion of the pinion **19** into a straight linear motion to move upward or downward the discharge outlet door **13** when the pinion **19** is rotated. Guides **23** are mounted on the housing for guiding the travel of the discharge outlet door **13**.

Furthermore, photo-sensors **25** and **27** are respectively installed at upper and lower portions of the discharge outlet door **13** and at upper and lower portions of the guide **23**, for detecting an open or a closed state of the discharge outlet door **13** for automatically controlling the up or down movement of the discharge outlet door **13**.

If a user selects a desired operational mode through a remote controller or a manual manipulating panel and then depresses a start/stop key (hereinafter referred to as the operation key), the door motor **17** is rotated in the forward direction to thereby rotate the pinion axially coupled to the shaft of the door motor **17**, so that downward movement of the rack **21** caused by the pinion **19** causes the discharge outlet door **13** to be also moved downward, thus opening the discharge outlet **5**.

At this time, when the photo-sensors **25** and **27** detect that the discharge outlet **5** is opened, the door motor **17** stops, and at the same time an indoor fan, not illustrated, is rotated to take in the room air into the body **1** through the suction inlet **3**. Then, the room air introduced into the body **1** through the suction inlet **3** is heat-exchanged by the evaporating latent heat of the refrigerant flowing in the heat-exchanger when the sucked air passes through the heat-exchanger.

The air heat-exchanged through the heat-exchanger is guided into an upper portion of the body **1** and then discharged indoors in an air flow direction according to a controlled displacement of air vanes or blades **9**, **11** for accomplishing the conditioning of the room air.

If the operation key is OFF during a normal operation of the air conditioner, the door motor **17** is rotated in the reverse direction to cause the discharge outlet door **13** to be moved upward, and thus the discharge outlet **5** is closed. At this time, when the photo-sensors **25** and **27** detect that the discharge outlet **5** is closed, the door motor **17** stops, and the air conditioner maintains its stand-by state until the operation key is again ON.

Even if the conventional air conditioner has merit in that the closing of the discharge outlet **5** prevents introduction of dust or foreign substances into the main body **1**, there is a problem in that the air discharge position cannot be varied, for the discharge outlet **5** is fixed. Therefore, the conventional air conditioner cannot be adapted for changing the discharge position due to the state and dimension of the space in a room to be conditioned, and the place at which the air conditioner is to be installed, etc. Furthermore, since the air conditioner includes the indoor fan and the heat-exchanger, etc., and the discharge outlet **5** is fixed on the upper portion thereof, the overall size of the product is relatively long, which makes it difficult to deliver the product which occupies a wider space in installing the air conditioner.

Moreover, since the photo-sensor **25**, **27** for detecting the discharge outlet door **13** which moves upward or downward is mounted adjacent to the discharge outlet **5**, and since undesirable moisture may be produced during the conditioning of the air, the photo-sensor **25**, **27** may malfunction. Furthermore, the door motor **17** may be out of order. In case of these occurrences, the discharge outlet door **13** cannot be opened or closed, which causes a problem since the air conditioner cannot be used.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a discharge outlet opening or closing apparatus for the air conditioner whose discharge outlet can be placed at various positions and whose vertical length can be varied, and an associated method.

It is another object of the present invention to provide a discharge outlet opening or closing apparatus for an air conditioner in which a position of a discharging means can be accurately detected, and a moving operation of the discharging means can be accurately performed using an auxiliary motor when degradation or a malfunction of a main motor for moving upward or downward the discharging means occurs.

The above objects are accomplished by an air conditioner having an apparatus for closing or opening a discharge outlet, the air conditioner being adapted for taking in and heat-exchange indoor air, and then discharging the heat-exchanged air, wherein the apparatus comprising:

discharging means having a discharge outlet at one side thereof, which is vertically moved at an upper portion of a main body, for thereby defining a vertical position of the discharge outlet with the movement of the discharging means;

driving means for vertically moving the discharging means;

closing/opening detecting means for detecting positions of the discharging means moved; and

control means for controlling the driving means based upon a detection result from the closing/opening detecting means.

Furthermore, according to another aspect of the present invention, there is provided a method for closing or opening a discharge outlet of the air conditioner of the present invention, the method comprising the steps of:

establishing a desired discharging position at which discharging means is to be positioned;

controlling driving means in response to the established discharging position and moving upward or downward the discharging means; and

detecting positions of the discharging means moving upward or downward.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and aspects of the invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

FIG. **1** is an exploded schematic front perspective view illustrating a discharge outlet opening or closing apparatus for a conventional air conditioner;

FIG. **2** is a schematic front perspective view illustrating an air conditioner according to the present invention, with the discharge outlet closed;

FIG. **3** is a schematic front perspective view illustrating an air conditioner according to the present invention, with the discharge outlet opened;

FIG. **4** is a rear perspective view illustrating the configuration of ascending or descending means according to an embodiment of the present invention;

FIG. **4A** is a perspective view of a detecting mechanism used in FIG. **4**;

FIG. **5** is a rear perspective view illustrating the configuration of ascending or descending means according to another embodiment of the present invention;

FIG. **6** is a schematic perspective view of a mechanism for transferring an auxiliary motor in FIG. **5**;

FIG. **7** is a control block diagram of the discharge outlet opening or closing apparatus for the air conditioner according to the present invention;

FIG. **8** is a detailed circuit diagram of a control system according to the present invention; and

FIG. **9A–9C** are flow charts illustrating sequential control procedures for opening or closing the discharge outlet of the air conditioner.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiment according to the present invention will now be described in detail in accordance with the accompanying drawings.

As shown in FIG. **2** and FIG. **3**, a main body **100** has a suction inlet **102** arranged to suck a room air at the bottom portion of a front face of the body **100**, and a discharge outlet **104** for discharging indoors the air heat-exchanged by a heat-exchanger, not illustrated, which serves to heat-exchange the air with cold or warm air. The outlet is situated at the upper portion of the front face and is pivotally provided with blades **106** for adjusting a flow direction of the discharged air from the discharge outlet **104**. Also, the blades **106** are connected to an internal motor, not illustrated, for adjusting the displacement of the blades **106**.

The main body **100** is provided on an upper portion thereof with discharging means **108** having the discharge outlet **104**, where the discharging means serves to open the discharge outlet during the operation of the air conditioner, and to close the discharge outlet **104** for preventing dust or foreign substances from passing through the discharge outlet **104** and into the main body during the stand-by state of the air conditioner. The discharging means **108**, designed to give a good appearance, is a box-shaped structure having a partially opened front surface constituting the discharge outlet **104**, and an opened bottom, and is adapted to be moved upward and downward as shown in FIG. **3**.

And, above an area at which the suction inlet **102** is located, there is disposed a manual manipulating portion **110** for directing desired operation modes of the air conditioner such as automatic mode, cooling, heating, defrost, air-cleaning, and so forth, and a start/stop of the air conditioner, and for adjusting the flow amount or flow direction of the air discharged through the discharge outlet **104**.

Referring to FIG. **4**, the main body **100** has a rear surface on which a motor **121** for moving up or down the discharging means **108** is fixedly installed. The motor **121** has a shaft axially coupled to a pinion **122**. The discharging means **108** is provided at a rear surface thereof with a vertically elongated rack **123** having one end fixed to the discharging means **108** by means of a coupling member **124**. The rack is for changing the rotary motion of the pinion **122** into linear motion in cooperation with teeth of the pinion **122**. A guide means **120** has a guide wall **125** for guiding the up or down movement of the rack **123** and also additionally serving to support the motor **121**.

A lower portion of the rack **123** is provided with a stopper **126** for limiting the upward travel distance of the discharging means **108** to less than the overall height dimension of the rack **123**. This allows an upper limiting position of the discharging means **108** to be defined by the stopper **126**. And, a lower limiting position of the discharging means **108** is defined by a stepped portion **127** formed in the main body **100**, for this stepped portion contacts the lower portion of the discharging means **108** and restrains further downward movement thereof **108**.

Upward straight line motion of the rack **123** caused by the rotary motion of the pinion **122** due to the rotation of the motor **121** causes the discharging means **108** to move upward whereby the outlet **104** travels above a front wall **100A** of the body **100** and thereby becomes opened. The air sucked through the suction inlet **102** is discharged indoors through the discharge outlet **104** wherein the higher the discharging means **108** is elevated, the wider the discharge outlet **104** is opened, and vise versa.

The discharging means **108** has a sensor actuating member **131** fixedly coupled thereto on the rear side of the discharging means **108** by means of a coupling member **132**, where the sensor driving member **131** has a plurality of equidistantly located holes **131***a* through **131***f*, such that each of the holes corresponds to a given position of the discharging means **108** elevated.

The main body **100** is provided at its rear surface with a photo-sensor **133** having a light emitting portion **133***a* and a light receiving portion **133***b* which can be triggered by a plurality of holes **131***a* through **131***f* of the sensor actuating member **131**. The ON/OFF state of the photo-sensor **133** is due to the plurality of holes **131***a* to **131***f* which pass through the passage between the light emitting portion **133***a* and the light receiving portion **133***b* of the photo-sensor **133** in response to the ascending or descending of the discharging means **108**. The sensor actuating member **131** and the photo-sensor **133** constitute an elevation detecting mechanism **130**.

The member **131**, when the motor **121** is rotated in either the forward or reverse direction, ascends and descends through a space formed between the light emitting portion **133***a* and the light receiving portion **133***b* of the photo-sensor **133**, thus allowing any one of the holes **131***a* through **131***f* to conduct the light emitted from the light emitting portion **133***a* to the light receiving portion **133***b*. Control means, of which details will be discussed later, counts the number of detection signals received from the photo-sensor **133** and determines the current position of the moved discharging means **108**.

The discharging means **108** can be at any one of 1st through 5th positions with the following relationship: 1st position <2nd position <3rd position <4th position <5th position, i.e. the fifth position is the highest. A plurality of holes **131***a* to **131***f* formed in the sensor driving member **131** include 1st through 5th holes **131***b*, **131***c*, **131***d*, **131***e*, **131***f* for respectively detecting the position of the discharging means **108** at any of the respective 1st through 5th positions.

Next, the configuration of the ascending or descending means in accordance with another preferred embodiment of the present invention will be described with reference to FIGS. **5** and **6**.

As shown in FIG. **5**, the main body **140** has a rear surface upon which a motor **141** for moving upward or downward the discharging means **108** is fixedly mounted. The door motor **141** has a shaft axially coupled to a pinion **142**. The discharging means **108** is provided at a rear surface thereof with rack **143** having one end fixed to the discharging means **108** by means of a coupling member **146** and gears **144**, **145** formed on both of sides of the rack **143**, for changing the rotary motion of a pinion **142** into linear motion in cooperation with teeth of the pinion gear **142**. The motor **141** rotates the pinion **142** engaged with the right gear **144** of the rack **143** for exercising up or down straight linear motion and for thereby moving upward or downward the discharging means **108**.

Position sensors **155**, **157**, **159** are disposed in line with the rack for detecting the position of the moved rack, where the positions to be detected include upper limiting, reference and lower limiting positions. Preferably, each of the position sensors **155**, **157**, **159** may comprise a photo-interrupter mounted on the housing **140**.

Meanwhile, as shown in FIG. **6**, to cope with the degradation of the door motor **141** and to enable the rack **143** to be moved despite a degraded door motor **141**, an auxiliary pinion **147** is spaced a short distance from the gear **145** formed on the left side of the rack **143**. The pinion **147** is axially coupled to a shaft of an auxiliary motor **148** supported by a transfer member **150** having a transfer rack **149** formed on a longitudinally extended top portion of the transfer rack **149**. And, since the transfer rack **149** engages with a transfer pinion **152** axially coupled to a shaft of a transfer motor **151** to transfer the pinion **147** toward or away from the gear **145** in a direction D. Hence, the auxiliary pinion **147**, in case of degradation of the door motor **141**, is engaged with the left gear **145** of the rack **143**.

Hereinafter, for such a structured air conditioner, the control for moving upward or downward the discharging means **108** will be described with reference to FIGS. **7** and **8**.

As shown in FIGS. **7** and **8**, power supply means **200** serves to receive an electrical source voltage of commercial AC electrical power supplied from an AC power source stage **101**, not illustrated, to convert the same to a predetermined DC voltage necessary for operation of the air conditioner and output the same. Key manipulating means **202** has a plurality of keys for selectively establishing the operational modes such as automatic mode, cooling, heating, defrost, air-cleaning, and so forth, of the air conditioner, an amount of air flow such as strong, weak, soft and so forth and the desired temperature Ts (hereinafter, referred to as a set temperature), as well as an operation key for a start/stop of the air conditioner and an outlet position adjusting key for adjusting and establishing various positions of the discharging means **108** within the predetermined range.

Control means **204**, which may comprise a microprocessor, receives direct voltage output from the power supply means **200** to initialize the air conditioner, and also controls a general operation of the air conditioner in response to an operation selection signal input through the key manipulating means **202**. Also, the control means **204** controls the movement of the discharging means **108** in response to the key input signal through the key manipulating means **202**.

Position detecting means **206** is provided for detecting a closed or open state of the discharge outlet **104**, corresponding to the position of the discharge outlet **108**, and for outputting the detected signal to the control means **204**. The position detecting means **206** comprises a position detecting portion **208** for detecting a specific position resulting from the up or down movement of the discharging means **108** and an electric current detecting portion **210** for detecting an electric current generated in response to a closed or an open state of the discharge outlet **104**. The position detecting portion **208** may be embodied by the ascending or descending portion **130**, or by the position sensors **155**, **157**, **159**.

An electric current detecting portion **210** of the position detecting means **206** includes a transformer CT for detecting an electric current flowing through a winding of the door motor **121**, such that when further movement of the discharging means **108** past the upper and lower limiting positions is restrained by stops, an abrupt rise of the electric current due to the stationary state of the door motor is detected for identifying the arrival at the upper limiting position of the discharging means **108**. Such identified arrival is signaled to the control means **204**, via a bridge diode BD for full-wave rectifying the current detected by the transformer CT, and a smoothing capacitor C for filtering ripple components contained in the full-wave rectified DC current.

Motor driving means **212** including motors **121**, **141** and switching elements SW2, SW3 for controlling supply of the power into the motors **121**, **141** is provided to establish rotation directions of the door motors **121**, **141** based upon the control signal output from the control means **204** for controlling the movement of the discharging means **108** in compliance with the key input signal through the key manipulating means **202**. Auxiliary motor driving means **214** is provided to control the driving of the auxiliary motor **148** based upon the control signal output from the control means **204** for controlling the movement of the discharging means **108** in cooperation with the motors **121**, **141** in case of a degradation of the motors **121**, **141**.

Transfer motor driving means **216** is provided to control the driving of the transfer motor **151** based upon the control signal output from the control means **204** for transferring the auxiliary motor **148**. Load driving means **208**, including switching elements SW1, SW4 for controlling supply of the power into the compressor **220** and indoor fan **222**, is provided to control the driving of the compressor **220**, the

indoor fan **222** and a blade **106** for adjusting air flow direction under the control of the control means **204**.

The operation and advantages of such a structured discharge outlet closing/opening apparatus for the air conditioner and method therefor will be described.

FIG. **4** is a perspective view showing the rear side of the ascending or descending means according to one preferred embodiment of the present invention, and FIG. **9** is flow charts illustrating sequential control procedures for opening or closing the discharge outlet of the air conditioner.

It is assumed that the discharge outlet **104** remains closed as an initial condition for the purpose of the explanation.

First, when a power is applied to the air conditioner, the power supply means **200** performs such that a commercial AC power supplied from an AC power stage **101** is converted into a DC voltage with a voltage level required to activate the air-conditioner, in which the converted DC voltage is applied to the control means **204** and each of the driving circuits.

When a DC voltage from power supply means **20** is applied to control means **204**, the air conditioner is initialized by the control means **204**. If the user sets the desired operational mode (such as automatic mode, cooling, heating, defrost, air-cleaning, and so forth) and temperature Ts, and then depresses an operation key, an operation selection signal and operation start signal (hereinafter, referred to as an operation signal) are applied to the control means **204**.

Thus, at step **S1**, the control means **204** determines whether the operation signal is applied or not, and if not (in case of NO), it maintains a stand-by of the air conditioner and repeats step **S1**.

If the operation signal is input (in case of Yes), the process advances to step **S2** in which the control means **30** receives an outlet position command corresponding to the position of the discharging means **108** selected by the user who manipulates the door key adjusting key in the key manipulating means **202**. Then the control means **204** initializes a counter provided for counting the occurrences of signals detected corresponding to the position of the discharging means **108**.

At this time, the control means **204** receives a signal of a high level maintained for a time period, through a start hole **131***a* of the sensor actuating member **131**.

Next, at step **S4**, it is determined whether the outlet position command generated from the manipulation of the outlet position adjusting key corresponds to the first position or not. If yes (in case of YES), the process advances to step **S5** where the motor driving means **212** receives from the control means **204** a control signal for adjusting the position of the discharging means **108** to the first position.

Therefore, the motor driving means **212** drives the motor **121** in the forward direction under the control of the control means **204**. This allows the pinion **122** coupled to the shaft of the motor **121** to rotate therewith, causing the rack **123** to be moved upward. Thus, the discharging means **108** coupled to the rack **123** ascends to open the discharge outlet **104**, wherein the opening of the discharge outlet **104** is varied dependent upon the ascending of the discharging means **108**.

As the discharging means **108** ascends due to the forward rotation of the motor **121**, the sensor actuating member **131** ascends, during which the light having been passed from the light emitting portion **133***a* to the light receiving portion **133***b* by way of the start hole **131***a* becomes temporarily blocked. This allows a low level signal to be applied to the control means **204** which has previously received the high level signal. With the continued ascending of the discharging means **108**, when the first hole **131***b* of the sensor actuating member **131** is placed between the light emitting portion **133***a* and the light receiving portion **133***b*, a high level signal is applied to the control means **204**. Then, at step **S6**, since the counter increases by 1 each time the high signal from the photo-sensor **133** is input, the control means **204** knows the position of the discharging means **108**.

At this time, at step **S7**, to determine whether or not discharging means **108** reaches the first position set by the user through the manipulation of the door position adjusting key, the control means **204** checks whether the content of the counter indicates 1 or not, and if not (in case of NO), the process returns to step **S5** where the control means continues to rotate the motor **121** in the forward direction until the content of the counter reaches 1 by repeatedly performing steps **S5** to **S7**.

As a result of the determination at step **S7**, if the counter has the value 1 (in case of YES), the process advances to step **S8** where the control means **204** determines that the discharging means **108** has moved from the start hole **131***a* to the first hole **131***b*, and then stops the motor **121**. The ascending of the discharging means **108** is thus completed.

Then, at step **S9**, in compliance with the operational mode, set temperature and air flow direction established through the key manipulating means **202**, the compressor **220** and the indoor fan **222** are driven to condition the room air.

For such a normal operation of the air conditioner, at step **S10**, it is determined whether the stop command signal generated by an OFF position of the operation key of the key manipulating means **202** is applied, and if not (in case of NO), the process returns to step **S9** where the normal operation continues and steps **S9** and **S10** are repeated.

As a result of the determination at step **S10**, if the stop command signal is input (in case of YES), the process advances to step **S11** where the control means **204** outputs the control signal to the motor driving means **212** for returning to an initial position of the discharging means **108** presently moved to the set position.

Therefore, the motor driving means **212** drives the motor **121** in the reverse direction under the control of the control means **204**. This allows the pinion **122** coupled to the shaft of the motor **121** to rotate therewith, causing the rack **123** to be moved downward. Thus, the discharging means **108** coupled to the rack **123** descends to close the discharge outlet **104**.

As the discharging means **108** descends due to the reverse rotation of the motor **121**, the sensor actuating member **131** descends, during which the light having passed from the light emitting portion **133***a* to the light receiving portion **133***b* by way of the first hole **131***b* becomes temporarily blocked. This allows a low level signal to be applied to the control means **204** which has previously received the high level signal. With the continued descending of the discharging means **108**, when the start hole **131** of the sensor driving member **131** is placed between the light emitting portion **133***a* and the light receiving portion **133***a*, a high level signal is applied to the control means **204**. Then, at step **S12**, the counter decreases by 1 each time the high signal from the photo-sensor **133** is input, and then the control means **204** know the present position of the discharging means **108** as it descends.

At this time, at step **S13**, to determine whether or not discharging means **108** reaches the start position, the control means **204** checks whether the content of the counter exhibits 1 or not, and if not (in case of NO), the process

returns to step S11 where the control means continues to rotate the motor **121** in the reverse direction until the content of the counter reaches 0 by repeatedly performing steps S5 to S7.

As a result of the determination at step S13, if the counter has the value 0 (in case of YES), the process advances to step S14 where the control means **204** determines that the discharge outlet door **108** has moved from the first hole **131***b* to the start hole **131***a*, and stops the motor **121**. The descending of the discharging means **108** is thus completed. And, the air conditioner maintains the stand-by state until the operational key is activated.

The invention being thus described as to the procedures with the first position established, the same procedures, comprising controlling the driving of motor **121**, as described above would be applied to the case of another position established such as 2nd, 3rd, 4th, or 5th positions. More specifically, the control means **204** controls to stop the motor **121** for completing the ascending of the discharging means **108** through step S8 advanced in case after rotating the motor **121** in the forward direction for elevating the discharging means **108**, while the detections from the photo-sensor **133** are counted up to 2, 3, 4, and 5 in proportion to the respective ascending positions of the door as in steps S23, S33, S43, and S53, and then the control means **204** stores the above count.

If the user sets the position of the discharging means **108** to the 3rd position through the manipulation of the door position adjusting key, the control means **204** receives initially a high level signal issued when the light emitting portion **133***a* and the light receiving portion **133***b* has the start hole **131***a* interposed therebetween, and subsequently in succession high level signals are issued each time the 1st and 2nd holes **131***b*, **131***c* are interposed between the light emitting portion **133***a* and the light receiving portion **133***b* as the discharging means **108** ascends. During a time period existing between the high level signals, the control means **204** receives a low level signal issued due to a temporary absence of the light to be received at the light receiving portion **133***b* as the sensor actuating member **131** is elevated according to the driving of the door motor **121**.

Thus, the control means **204** rotates the motor **121** in the forward direction until the control means **204** receives the high level signal issued when the sensor actuating member **131** reaches the 3rd hole **131***d* to allow the discharging means **108** to ascend to the position corresponding to the 3rd position, and stops the motor **121** when the above high level signal is available.

At this time, the control means **204** stops the discharging means **108** in case the discharging means **108** completes its ascending operation to the target position based upon the counted number of high level signals from the photo-sensor **133**, and then the control means **204** stores the above number.

In case the user desires to close the discharge outlet **104** requiring the descending of the discharging means **108**, the motor **121** is reversely rotated to cause the discharging means **108** and the sensor actuating member **131** to descend, so that the counter decreases by 1 each time the photo-sensor **133** outputs the high level signal as the light receiving portion **133***b* of the photo-sensor **133** intermittently receives the light in constant time intervals by the respective holes **131***a* to **131***f* encountered during the descending of the sensor actuating member **131**.

When the number of the counting is equal to zero, the descending of the sensor actuating member **131** is finished. At this time, since the start hole **131***a* is positioned between the light emitting portion **133***a* and the light receiving portion **133***b*, the motor **121** stops, thus completing the descending of the discharging means **108**.

Now the operation principle for performing the movement of the discharging means **108** without requiring a sensor will be explained with reference to FIGS. **4** and **8**.

FIG. **4** is a perspective view showing the configuration of the ascending or descending means according to one preferred embodiment of the present invention, and FIG. **8** is a detailed circuit diagram of the main portions applied to the present invention.

When the discharging means **108** is moved up by the forward rotation of the motor **12**, and after the lapse of a predetermined time duration in which the motor **121** is driven (the time duration corresponds to a duration required to normally raise or lower the discharging means), a comparison is made between a reference value and the electric current value flowing in a winding of the motor **121**, detected by a current detecting portion **210**.

For the detected current above the reference value, it is determined that the discharging means **108** has been normally moved up or down, and thus the motor **121** stops.

For the detected current below the reference value even after the time period of the driving of the motor **121** has already lapsed, it is determined that a false operation like idle rotation has occurred. Then, the overall operations are suspended and the occurrence of a false operation is signaled. The preferable position detecting operation of the discharging means **108** without a sensor can be effected accordingly.

Even if the control of the movement of the discharging means **108** can be controlled to arrive at the specific position set by the user, or can perform the controlled movement of the discharging means **108** without using a sensor, a degradation of the door motor **121** may occur due to various causes. To cope with such an occurrence details will be described with reference to FIGS. **5** and **6**.

FIG. **5** is a perspective view showing the configuration of the ascending or descending means according to another embodiment of the present invention, and FIG. **6** is a schematic perspective view for explaining a transfer mechanism of an auxiliary motor in FIG. **5**.

Due to the degradation of the door motor **141** or **121** in FIG. **4**, the time duration which the lower portion of the rack **142** takes to arrive at the reference position may increase and exceeds the reference time duration. The exceeded time duration can be measured by the control means **204** for determining the door motor degradation based upon the counting of the time duration taken to arrive at the reference position of the discharging means **108** by the driving of the motor **141**. If the control means **204** determines that the motor has degraded, the auxiliary motor **148** is driven to horizontally move the auxiliary pinion **147** into engagement with the left gear **145** of the rack **143**.

When the auxiliary pinion **147** is brought into the engagement with the left gear **145** of the rack **143**, the auxiliary motor **148** is rotated together with the motor **104** to move upward or downward the discharging means **108**, wherein the rotational speed of the auxiliary motor **148** should be set to be equal to the speed of the motor **141**.

When the lower portion of the discharging means **108** reaches the upper (or lower) limiting position with the driving of both the motor **141** and the auxiliary motor **148**, both the motor **141** and the auxiliary motor **148** stop, thus the

moving operation of the discharging means **108** can be properly performed.

The forgoing disclosure being thus described as to the examination of the performance of the motor **141** by utilizing the position sensors **155**, **157**, **159**, but not limited thereto, a modification can be made such that in case the lower portion of the rack does not arrive at the upper (or lower) limiting position after the lapse of the pre-set time duration, the auxiliary motor **148** is then additionally utilized.

According to the discharge outlet opening or closing apparatus for the air conditioner and the associated method therewith in accordance with the present invention, various ascending or descending positions of the discharging means **108** can be respectively established, thus allowing the discharge outlet **104** to be opened or closed, and the length of the product can be varied. Also, any position of the discharging means **108** can be accurately detected, and the moving operation of the discharging means **108** can be accurately performed using the auxiliary motor **148** driven at the same time, even if the degradation or a malfunction of the motor **121**, **141** occurs.

Having described specific preferred embodiment of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.

What is claimed is:

1. An air conditioner comprising:

a housing having an air inlet adjacent a lower portion thereof for admitting air into the housing to be heat exchanged therein;

an air discharge member mounted at an upper end of the housing and including an outlet opening for discharging the heat-exchanged air; the discharge member being movable up and down relative to the housing; the outlet opening being closed by a portion of the housing when the discharge member is in a lowermost position, and being progressively opened in response to being raised;

a drive mechanism for raising and lowering the discharge member;

a detecting mechanism for detecting when the discharge member is in lowermost and uppermost positions, and

a controller connected to the drive and detecting mechanisms for controlling the drive mechanism in accordance with signals received from the detecting mechanism.

2. The air conditioner according to claim **1** wherein the controller is connected to a signal input number to enable users to input instructions thereto.

3. The air conditioner according to claim **1** wherein the drive mechanism comprises a motor, a pinion fixed to an output shaft of the motor, a toothed rack fixed to the discharge member and engaged with the pinion, and a stop for stopping the discharge member in its uppermost and lowermost positions, respectively.

4. The air conditioner according to claim **1** wherein the drive mechanism includes a first motor operably connected to the discharge member, and an auxiliary motor movable into operable connection with the discharge mechanism.

5. The air conditioner according to claim **1** wherein the detecting mechanism is operable to detect when the discharge member is in at least one intermediate position between the uppermost and lowermost positions.

6. The air conditioner according to claim **1**, wherein the drive mechanism includes an electric motor operably connected to the discharge member; the air conditioner further including stops for terminating movement of the discharge member at its uppermost and lowermost positions, respectively; the detecting mechanism including a position detecting mechanism which detects up and down movements of the discharge member, and a current detecting mechanism for detecting current variations in the motor in response to the discharge member being held by a stop at the uppermost or lowermost position.

7. The air conditioner according to claim **6** wherein the position detecting mechanism comprises a sensor and a sensor-actuating device being movable with the discharge member.

8. The air conditioner according to claim **7** wherein the sensor is a photo-sensor which includes a light emitter and a light receiver, the sensor-actuating device including vertically spaced holes for sequentially conducting light from the emitter to the receiver during up and down movement of the discharge member.

9. The air conditioner according to claim **6** wherein the current detecting mechanism comprises:

a transformer for detecting varying electric current of the motor;

a bridge diode for full-wave rectifying the current detected by the transformer; and

a smoothing capacitor for filtering ripple components contained in the full-wave rectified DC current.

10. A method for opening and closing an air outlet of an air conditioner, the air conditioner including a stationary housing and a discharge member mounted on the housing for vertical movement relative thereto, the air outlet being formed in the discharge member and being opened and closed in response to the vertical movement; the method comprising the steps of:

A) selecting a desired position for the discharge member;

B) actuating a drive mechanism which moves the discharge member vertically toward the selected desired position;

C) detecting positions of the discharge member as it moves vertically; and

D) deactuating the drive mechanism automatically when the discharge member reaches the selected desired position.

11. A method for opening and closing an air outlet of an air conditioner, the air conditioner including a stationary housing and a discharge member mounted on the housing for vertical movement relative thereto between upper and lower positions at which the discharge member is halted by respective stops, the air outlet being formed in the discharge member and being opened and closed in response to the vertical movement; the method comprising the steps of:

A) actuating an electric motor to drive the discharge member in a desired vertical direction;

B) detecting a current level in the motor indicative of a current level occurring when the discharge member is stopped; and

C) deactivating the motor when such current level is detected.

12. The method according to claim **11**, wherein the motor comprises a first motor, and further including the steps of determining when the first motor is malfunctioning, and actuating a second motor for vertically moving the discharge member.

13. The method according to claim 12 wherein the second motor is out of operable engagement with the discharge member during a non-malfunctioning state of the first motor; the step of actuating the second motor being preceded by the step of moving the second motor into operative engagement with the discharge member.

14. The method according to claim 13 wherein the step of determining when the first motor is malfunctioning comprises comparing a time period for the discharge member to be moved to a selected position with a reference time value.

15. The method according to claim 12 wherein the step of determining when the first motor is malfunctioning comprises comparing a time period for the discharge member to be moved to a selected position with a reference time value.

16. The method according to claim 15 wherein the first motor continues to be activated during actuation of the second motor.

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